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## AGRICULTURAL RESEARCH IN THE WAR AND AFTER[1]

By Dr. E. C. AUCHTER

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RESEARCH workers in our State agricultural experiment stations, in the Federal Department of Agriculture, in universities and other research and educational institutions and in industry have faced a tremendous challenge during this war. That they are meeting it successfully is witnessed by the result—an unprecedented agricultural production, the development and utilization of new foods, drugs, fibers and strategic materials of many kinds; improved methods of distribution, packaging and processing of agricultural products; and increased knowledge of requirements for foods and other products needed in everyday living. These results have been made possible by utilizing the materials and knowledge accumulated through scientific research, as well as by effective organization for developing new knowledge to meet emergency needs. Scientists in all fields related to agriculture are playing an important part in this work and will play an even more impotant one in the future. Just as great a challenge awaits research in the post-war world as it faces now. By continuing to work together we shall be able to meet it.

But an overwhelming number of demands tumble upon each of us these days. In the complexity of details it is both difficult and important to keep the major problems clear and if possible see the general direction in which we are moving. So the question I wish to propound this morning is: What is the real value of the agricultural and related research work being carried on year after year in the form of thousands of big and little projects? We know that it is helpful to solve a lot of individual problems—but what do such solutions contribute as a whole for this nation and for mankind?

This question can be divided into three parts: What has agricultural research done in the past? What is it doing now? What can it do in the future?

[1] Address given at the fifty-seventh annual convention of the Association of Land-Grant Colleges and Universities, Chicago, Ill., October 27, 1943.

I realize that it would take many books and the knowledge and wisdom of many minds to answer these questions fully. I shall suggest only a few of the answers.

### Research Shaped Our Civilization

If this meeting were being held in 1787, the year the Constitution was written, we would probably be a gathering of farmers. Nineteen people out of every twenty in those days lived on farms. Nineteen farm families could produce only enough surplus, beyond their own needs, to feed and clothe that one non-farm family. But we are meeting in 1943—and I assume that there is not one of us in this room who devotes himself exclusively to farming. Many of us came from farms originally (and some of us would like to be back there again). But we're not on farms—in fact, there are now only about four farm families in this country to each 20 non-farm families. China still has 19 farm workers to one non-farm worker—exactly where we were in 1787.

The conditions that have made it possible for so large a proportion of our families to be released from the necessity of being on farms have also made it possible for us to have in the United States so many roaring steel factories—networks of railroads—airplanes—automobiles—telephones—refrigerators—business and professional services of all kinds—and to turn out such huge quantities of material for ourselves and our Allies in this war. A comparatively few farmers can produce enough to feed and clothe many other people who can work in offices and factories and laboratories because they are not required to produce food and fiber directly for themselves.

These facts are generally known but are so elementary that we overlook them. I review them here because they summarize, more strikingly than anything else I can think of, what agricultural research has done and made possible in the past. It has increased agricultural efficiency, step by step, year by year; and that in turn has played a large part in enabling us to build and operate great industries.

It would be absurd and untrue, of course, to say that only research directly connected with agriculture has made our industrial development possible. Progress is based on the exchange of knowledge developed in many fields. But the fact remains that the research of the land-grant colleges, the State experiment stations, the U. S. Department of Agriculture and our universities and other institutions dealing more or less directly with agricultural and related problems has not only paralleled but to a large extent stimulated the great progress in agricultural efficiency made in this country since 1860—progress that helped make our industrial civilization possible. And our agricultural institutions have not been content with doing a vast amount of productive research; they have carried the results directly to the farmer and have shown him how to apply them, thereby cutting down the time that would otherwise be required for the adoption of new practises.

We are not going to stand still where we are. I believe that the possibilities for advance in the coming decades are at least as great as the achievements of the decades that are past. But we will not have these advances unless we maintain and in fact increase our agricultural research. In a civilization making such full use of applied science you have to run fast to stay where you are. If you want to move ahead, you have to run still faster.

### The Underpinning of Wartime Production

It is unnecessary to recall to this audience that after World War I there was a period of pessimism about research, especially during the depression, when there were huge surpluses of some farm products. There was a feeling that somehow research was at least partly to blame for those surpluses. It had shown us how to grow two blades of grass where one grew before, and now we apparently didn't need the second blade; no one wanted it, and it was a burden and a curse. With farmers experiencing such hard times, and many of them being driven out of business, some scientists wondered whether they were performing any really constructive function, and at times they were even made to feel rather uncomfortable.

The one good thing about the depression was that it finally drove home to many people that fact that those surpluses were not surpluses at all in relation to our needs, and certainly not in relation to world needs, since at least half of the world's people are not properly fed. The true situation was that scientific progress was far ahead, temporarily at least, of economic and social progress. We knew how to produce, but not how to get the products to the people who needed them. We did not know how to maintain what the economists call "effective demand."

Then came the present war. Incidentally, many think that modern war also is fundamentally due to the fact that economic and social progress have been unable to keep pace with scientific progress. But the war has completely reversed any feeling that we knew too much about how to produce. It automatically did what we were not wise enough to do in peace. The war created "effective demand," in terms of astronomical figures. And mark this point well—we could not have met that demand if it had not been for the advances our farmers have made in production on a scientific basis during the past few decades, coupled with the ability of those organized to serve the nation

—agronomists, horticulturists, soils experts, economists, entomologists, botanists, pathologists, agricultural engineers, biochemists, home economists, dairy and animal husbandmen, extension specialists, administrators, and others in many specialized branches of science—to mobilize and extend our resources quickly to meet new emergency problems. In very large measure, we were ready, and all these fields have been called upon and many individuals utilized in far greater measure than can be disclosed until peace has been restored.

### Mobilization of Research for War

I have said before that in a sense agriculture itself is a kind of warfare—against adverse weather conditions, lack of soil fertility, diseases, insects and all the other enemies of maximum production and utilization of farm products of many kinds. Agricultural research has long been mobilized, and must remain mobilized, in a campaign that will never end against these enemies.

But we have had to have a more intensive mobilization to meet the tremendous needs of to-day. More than two years ago, experiment station directors and staffs, seeing the problems ahead, started to scrutinize their station research projects carefully. In an effort to have funds, personnel and facilities available to tackle many new problems, certain of the regular projects which apparently would not make as immediate or direct contribution as some others to the war were laid by, so to speak, until after the war, or until circumstances indicated the need to resume or intensify work on them. The resources of the State agricultural experiment stations have been marshalled for the job of supplying facts to solve many of the problems involved in the record demands for food, feed and fiber occasioned by the war. Care has been taken, however, to prevent the loss of long-time experiments, such as soil fertility plots, and of valuable plant and animal material.

In the fiscal year 1942, Dr. Jardine, chief of the Office of Experiment Stations, tells me that there was an increase of 16 per cent. in the number of research projects undertaken by the States under Federal-grant funds compared with the average of the five preceding years, and that the regular research projects were modified where necessary to have them contribute more directly to the war effort. In 1943, there were over a thousand research undertakings by the States involving cooperation with bureaus of the Agricultural Research Administration and agencies of the War Food Administration. Many of these projects, of course, had been in progress before the war.

In the Federal Department of Agriculture in December, 1941, the Secretary of Agriculture grouped several agencies into an Agricultural Research Administration with the purpose of coordinating and centering research activities of the department upon war needs. To review briefly: The field covered by the Research Administration includes the following research bureaus—Animal Industry, Dairy Industry, Human Nutrition and Home Economics, Entomology and Plant Quarantine, Agricultural and Industrial Chemistry, and Plant Industry, Soils and Agricultural Engineering—the Beltsville Research Center, the Office of Experiment Stations and the four Regional Laboratories devoted to research on the industrial utilization of farm products and by-products, and nine Bankhead-Jones laboratories devoted to research on certain agricultural problems common to groups of States in the major agricultural regions.

By coordinating the work of those research agencies even more closely than in the past, it is possible to plan and carry out concerted attacks on certain problems and get important results more quickly than would have been possible without such close teamwork. Early in the war, we in the department also critically examined our whole list of projects, laid aside work that could be postponed if it did not bear immediately on war needs, reoriented other projects to meet wartime demands, and prepared to take on the many emergency projects that have been continually developing since the war began. In making these changes we, too, have been careful, of course, not to waste any stocks of valuable material or jeopardize long-time research programs. Ninety-two per cent. of current research activities in the Agricultural Research Administration are directly connected with the war.

The ability of this nation progressively to increase its production of food, feed and fiber during the past three years is due to a great extent to the large accumulation of data from past research and the all-out application of research agencies to the job of interpreting and applying accumulated facts and acquiring new facts which could be disseminated by extension agencies to the farmers, who were confronted with what looked to some an almost impossible task.

It was relatively easy for all of us to determine what increases of certain products were needed, but among other things, such as supplies of labor, farm machinery, fertilizer, etc., the accomplishment of the goals has involved greater efficiency in using soil resources; superior seed stocks of improved crop varieties; improved growing, harvesting, distribution and utilization practises; improved animal feeds and feeding, and reduction in losses from insect pests and diseases. In meeting the demands for more livestock, it was necessary to produce more feed, to make maximum use of pasture and roughages and to provide substitutes for some feedstuffs.

Vice-President Wallace emphasized the importance

of agricultural research in a statement he made recently: "It is only because of the extraordinary technological discoveries of the U. S. Department of Agriculture and the State experiment stations in soil management, crop breeding, and livestock feeding that we . . . have been able so far this year to ship food abroad at an annual rate of about 10 billion pounds." In other words, back of the ability to ship this great quantity of food, and at the same time feed our own people adequately, is the ability to produce food; and back of the ability to produce it are the intelligence and will of our farmers and the years of patient fact-finding of our scientists.

The emphasis and the concentration of investigators on special problems as well as the whole-hearted cooperation between State and Federal workers and those in other research and educational institutions have resulted in many contributions of decided value in the war. As perhaps never before, projects have been coordinated and the services of individuals with special technical knowledge have been used.

As examples illustrating how scientists have cooperated in attacking regional and national problems connected with the war, I might mention the nation-wide cooperative study of how best to conserve nutritive values of 69 different foods which is participated in by 46 experiment stations and the Department of Agriculture; and the cooperation of many State stations and the Department of Agriculture in determining where kok-saghyz (the Russian rubber-bearing dandelion) and various fiber and drug plants can be grown.

Many important agricultural problems during the past few years have been investigated by the nine Bankhead-Jones regional research laboratories. These laboratories were organized in cooperation with the State agricultural experiment stations and were located in different sections of the country. Valuable knowledge has already been obtained in the fields of vegetable breeding, salinity in irrigated soils, animal and poultry diseases, pasture improvement, soybean production, sheep and hog breeding and the interrelation of soils, plants and animal nutrition.

Similarly, the four regional laboratories at Albany, Calif., New Orleans, La., Philadelphia, Pa., and Peoria, Ill., organized to find new and industrial uses of farm products and by-products, have already made discoveries important to the war as well as to our domestic economy.

Thus, although faced with difficulties in retaining an adequate number of trained research workers and in maintaining essential facilities during the past two years, the experiment stations, the U. S. Department of Agriculture, universities and other research institutions have solved many new problems and have increased the volume of their services. A few examples will illustrate recent accomplishments:

(1) At the beginning of the war, we were dependent on foreign countries for supplies of certain drug, fiber and rubber goods obtained from plants. Now through the cooperation of the scientists at the State experiment stations, universities, research institutions, drug manufacturers, industrial research laboratories, farmers and the Federal Government, we have found ways of growing, harvesting and processing these crops. In some cases, our needs are wholly being met; in others, we are in position to meet most of the essential needs if it becomes necessary.

(2) Faced with a shortage of labor, the agricultural engineers cooperating with other scientists have originated new labor-saving machinery for the planting, production and harvesting of several crops and have modified other machinery and developed new practises for such purposes as refrigerated transportation.

(3) Faced with the necessity of conserving shipping space, scientists in many fields have cooperated in determining how to dehydrate, ship, store and reconstitute many food products such as meat, milk, vegetables, fruit and eggs without undue loss of palatability and nutritive quality.

(4) At the request of the armed forces, entomologists have developed new and original methods of freeing and protecting men from body lice, mosquitoes and other insects. In cooperation with other scientists, they have developed substitutes for some of the insecticides and fungicides formerly used in agricultural production and now scarce.

(5) Chemists, physiologists and other scientists have solved a host of specific problems such as developing more efficient methods of obtaining alcohol from wheat; preventing the deterioration of fabrics for domestic use and military purposes; finding ways to make soft, downy fluff out of chicken feathers to substitute for down from waterfowl for filling sleeping bags and pillows for the armed forces; making new plastics derived from wood and from crop residues; increasing the flow from pine trees of oleoresin, much needed by the armed forces; successfully transplanting trees and shrubs at different times of the year for camouflage purposes; and modifying sterility and increasing the milk flow of animals by the use of hormones.

(6) Home economists, among many other activities, have investigated and given advice on how to cook food on a large scale, under conditions such as those found in service camps, so as to achieve great savings of nutrients; have calculated the nutritive values of available and potential food supplies as a guide for production and rationing policies; have found ways to use alternate foods and fibers and distributed an immense amount of information on how to get the maximum use out of products no longer made in liberal quantities; and have designed clothes and uniforms for special purposes and conditions.

(7) Much work, in the aggregate, has been done on the problems of nutrition, particularly in relation to protein supplies for both human beings and livestock. With shortages of protein feeds, especially of animal origin, a

limiting factor in livestock production, physiologists have had to determine how little could be used and to what extent one source of protein could be substituted for another in rations. Chemists and others have worked on the problem of recovering as much valuable protein as possible from distillery by-products instead of having it go to waste; and, incidentally, a new method has been developed for making alcohol from wheat which may have possibilities for large-scale protein recovery. In the case of diets for human beings, one of the main problems has been to work out ways of using more protein directly from plant sources rather than have it converted first to meat in the animal organism. Work done with soybean, peanut and cottonseed products has shown the nutritional value of their proteins, and home economists have developed many recipes and formulas for the use of soybean products. In this connection, recent research on amino acids promises to give us a more accurate knowledge of protein nutrition than we have yet had.

During the war, too, plant breeders have carefully studied new materials of promise which were near the end of pre-distribution tests. Where certain ones possessed attributes which indicated they would reduce production risks, they have been increased for immediate farm use and distributed. The introductions have included cereals, fruits, vegetables, cotton, soybeans, sugarcane and other important crops.

I should like to discuss certain other contributions of value to the armed forces, but of course that can not be done now. Some day when all the contributions of science to the war can be told, they will make an extraordinary story.

### The Value of Fundamental Research

The few examples just given illustrate the originality, ability and cooperativeness of agricultural scientists. They show that agricultural research, both abstract and applied, carried on during peace times has been immensely useful in time of war. Naturally applied science must be stressed in all agricultural research carried on by public agencies. But the development of basic information and the discovery of principles upon which practise can be based make it possible to arrive at a more speedy, direct and satisfactory solution of problems. The whole progress of science and the application of its findings depends on filling in the gaps in our knowledge of the nature of things. There is a very definite limitation indeed to the extent of progress which can be made without a backlog of fundamental knowledge.

Hybrid corn, planted on approximately 50,000,000 acres this year, is a familiar example. We all know that the development of hybrid corn was preceded by a good deal of work which most people would consider purely theoretical genetics. Perhaps not all of it was essential to the practical breeding operations, but a good deal of it was. Waxy corn was a by-product of some of this work; it had no practical value at the time it was discovered but was carried along for its theoretical interest. Now it is of very great importance, along with waxy sorghum, as a source of a possible substitute for tapioca starch.

The work on the influence of day length on plant development and distribution is another case in point. Among many other things, an understanding of the photoperiodic requirements of different plants has affected agricultural production in widely different ways. It has made it possible, for example, to produce potato seed for breeding purposes under controlled conditions in large quantities, to determine the adaptability of many kinds of plants to widely separate areas and eliminate the practise of trying to grow them in regions to which they were not suited, and to control the blooming time of chrysanthemums and other florists' crops; and it has helped to make it possible for us to become independent of foreign sources of sugar-beet seed.

Another example is the seemingly abstract research on the effects of plant hormones on the physiological and anatomical responses of plants. This work has been applied to the prevention of early dropping of fruits, facilitating the rooting of plants for propagation and transplanting, wound healing, maintaining the dormancy of nursery stock, fruits and vegetables in storage, greatly increasing the percentage of fruit set on crops such as tomatoes, and increasing the size of some fruits. There have been many other applications, and a whole new chapter in man's control of plant development through chemical means is in the making.

An especially striking example of the importance of supporting fundamental research is found in the remarkable results now being obtained with penicillin in preventing or clearing up infections. All the funds that have been provided for many years to study the growth, reproduction, physiology, relationships and life histories of the many species of plants grouped under the general term "fungus" would be justified by this one discovery, even if all such work had not already been paid for very many times over by economic applications of the results of critical research. Because of the knowledge of investigators versed in the cultivation of fungi on a large scale, it will now be possible to produce large quantities of penicillin and save the lives of thousands of people.

These examples are singled out from among hundreds of outstanding contributions which have had their basis in fundamental research because they are of great current interest and because they bring home to us the direct connection between the accumulation of basic knowledge and its application in a highly practical and often dramatic way.

(*To be concluded*)

# OBITUARY

## CASWELL GRAVE

### January 24, 1870—January 8, 1944

CASWELL GRAVE was born and raised on a farm near Monrovia, Indiana. His parents were industrious and prosperous members in good standing of the Society of Friends, to which nearly every one in the community belonged. He was therefore from childhood surrounded by wholesome religious and social influences. He carried his full share of the responsibilities and often arduous duties of life on a farm until he graduated from Earlham College and entered the Johns Hopkins University in 1895, where he soon came under the influence of the eminent philosophical zoologist, W. K. Brooks. He remained in this institution as student, teacher and investigator until 1919, when he was called to Washington University, St. Louis, as professor of zoology and head of the department. He held this position until he retired in 1939 and moved to his new home in Winter Park, Fla.

Soon after graduating from the Johns Hopkins University with the Ph.D. degree he began investigations during the long summer vacations in the laboratory of the U. S. Commisison of Fish and Fisheries, first at Woods Hole, Mass., and later at Beaufort, N. C., where he was director of the laboratory for four seasons (1902–6). Here he became interested in the biology and the culture of the oyster, and later, after having devoted nearly his entire time to this subject for six years (1906–12) as shellfish commissioner of Maryland, he was widely recognized as the foremost expert on the subject in this country.

His investigations were extraordinarily ingenious, thorough and comprehensive and his writings rich in thoroughly substantiated, wise counsel concerning especially the oyster industry; counsel which although unfortunately frequently disregarded, has nevertheless been of great practical value.

Dr. Grave was for many years closely associated with the Marine Biological Laboratory at Woods Hole, Mass., as student, instructor, investigator and trustee (1901–44). Here and in the Carnegie Laboratory at the Dry Tortugas, Fla., he devoted much time to a comprehensive series of wisely planned and meticulously executed studies concerning the structure, development and interrelationship of ascidians. These studies were still in progress at the time of his death. The results obtained are profound in significance, especially those concerning the factors involved in the metamorphosis of the tadpoles.

In his extensive experience as a teacher and an executive Dr. Grave was eminently successful. He was always clear, precise, sympathetic, sincere and above all absolutely honest. The climax of his life's work in these fields was reached in Washington University, where in some ten years he built up a department from almost nothing to one of the foremost in the country, in research as well as in teaching.

For more than thirty years Caswell Grave was one of my most intimate associates. He was ever most generous in collaboration and very helpful and encouraging in criticism; wise in counsel and congenial in social intercourse, a true and trusted friend.

S. O. MAST

JOHNS HOPKINS UNIVERSITY

## RECENT DEATHS

DR. LEO HENDRIK BAEKELAND, honorary professor of chemical engineering of Columbia University, inventor of bakelite, died on February 23. He was eighty years old.

DR. EDWARD OSCAR ULRICH, geologist and paleontologist, died on February 22 at the age of eighty-seven years. Dr. Ulrich was a member of the U. S. Geological Survey from 1897 until his retirement in 1932. Since then he has continued his work at the U. S. National Museum, of which he had been an associate since 1914.

DR. DOUGLAS WILSON JOHNSON, Newberry professor of geology and chairman of the department of geology of Columbia University, died on February 24. He was sixty-five years old.

DR. FREDERICK GARDNER CLAPP, consulting geologist and petroleum engineer of New York City, died on February 18. He was sixty-four years old.

ELTON DAVID WALKER, professor emeritus of civil engineering at Pennsylvania State College, died on February 24 at the age of seventy-four years. He had been affiliated with the college since 1900, serving as head of the department of civil engineering from 1907 until his retirement in 1939.

DR. ROY E. DICKERSON, petroleum specialist for the technical branch of the Foreign Economic Administration, died on February 24 in his sixty-seventh year.

MILLER REESE HUTCHISON, of the Hutchison Laboratory, New York City, engineer and inventor, died on February 16 at the age of sixty-seven years.

DR. LEE WALLACE DEAN, professor emeritus of otolaryngology of the School of Medicine of Washington University, St. Louis, died on February 8. He was seventy-one years old.

DR. CHARLES W. BURR, professor emeritus of mental diseases at the School of Medicine of the Univer-

sity of Pennsylvania, died on February 19. He was eighty-two years old.

DR. ELEANOR ROWLAND WEMBRIDGE, psychologist, investigator of the Supreme Court, Los Angeles County, California, died on February 20 at the age of fifty years.

DR. ALEXANDER PRIMROSE, from 1918 to 1931 professor of surgery and from 1920 to 1932 dean of the faculty of medicine of the University of Toronto, died on February 8. He was eighty-two years old.

SIR JOHN FARMER, F.R.S., professor emeritus of botany, formerly director of the biological laboratories of the Imperial College of Science and Technology, South Kensington, died on January 26 in his seventy-ninth year.

DR. WILLIAM WHITEMAN CARLTON TOPLEY, from 1927 to 1941 professor of bacteriology and immunology at the University of London, and director of the School of Hygiene and Tropical Medicine, died on January 21 at the age of fifty-eight years. He was a member of the Scientific Advisory Committee of the War Cabinet and of the Colonial Research Advisory Committee.

# SCIENTIFIC EVENTS

## THE IMPERIAL COLLEGE OF SCIENCE AND TECHNOLOGY AND THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY

*The Times*, London, for January 14 prints the following letter from R. V. Southwell, rector of the Imperial College of Science and Technology, South Kensington:

Shortly after the last world war various colleges of Oxford and Cambridge "paired" in a voluntary and informal arrangement whereby each college so allied extends to members of its "opposite number" hospitality during occasional visits and the normal privileges of its common room. To-day a somewhat similar engagement is announced. The Massachusetts Institute of Technology has accepted proposals made by the Imperial College of Science and Technology to its president, Dr. Karl T. Compton, during his short visit to this country last summer, and the two institutions are planning to maintain, after the war, a regular interchange both of staff and of post-graduate students.

Somewhat exceptionally, of the two the American has the longer history. Its charter, stating among its purposes "the advancement, development, and practical application of science in connection with arts, agriculture, manufactures and commerce," was granted by the Commonwealth in 1861. Not until nearly fifty years later (in 1907) was Imperial College established with a charter stating closely similar aims: ". . . to provide . . . the most advanced training and research in various branches of science, especially in its application to industry." Thus "M.I.T.," as it is known throughout the world, has had a life of more than 80 years, and those years of peace; Imperial College has existed hardly half as long, and of its life nearly one quarter has been lived in time of war.

In view of this inequality, it need not be matter for surprise or jealousy that the American institution has the wider fame. It had, moreover, the advantage of being planned for its technological purpose from the beginning (by William Barton Rogers, of Virginia, its first president); Imperial College (as is the English way) was formed by an incorporation of three existing colleges, founded independently and with different aims. Add to this that in general the British bent has been towards pure science, that of America towards the side of practical application, and the fame of "M.I.T." requires no further explanation. It is ground for the more satisfaction to Imperial College that she should thus be recognized as its "opposite number"; and the alliance is an earnest of her intention to develop to the utmost, after the war, advanced technological instruction and research.

## THE PROPOSED SURVEY OF MARINE AND FRESH-WATER FISHERIES

SENATOR JOSIAH BAILEY, of North Carolina, chairman of the Senate Committee on Commerce, introduced in the Senate on January 26 a resolution directing the Fish and Wildlife Service to conduct a survey of the character, extent and condition of the marine and fresh-water fishery resources and other aquatic resources of the United States and its territories, including the high seas resources in which the United States may have interest or rights. The resolution sets forth in detail the type of information desired and requires a report on commercial and recreational fisheries to be submitted to Congress not later than January 1 next. If the resolution is adopted, it will be the first time since 1871 that Congress has of its own initiative directed a report of this nature.

Charles E. Jackson, assistant deputy coordinator of fisheries, in his remarks before the consultants of the Office of the Coordinator of Fisheries on February 3 spoke in part as follows:

To carry on proper exploration of the possibilities of our fisheries, a research vessel or vessels are essential. The United States is the only important maritime nation that is without a fishery research vessel, although our coastline is far more extensive than that of nations that have long had adequate research equipment. The history of our recent efforts to obtain a vessel are worth recounting briefly. The old *Albatross II* which the former Bureau of Fisheries operated was practically worn out in 1934, and since the Government policy at that time was to reduce expenses we could not justify its operation ex-

pense. Later when we requested relief funds to build a research vessel we were informed that funds would be allocated only to replace old vessels and on projects where no new personnel were needed. Unfortunately, the Bureau of Fisheries in good faith had several years previously abandoned its vessel and discharged its crew. The New England industry proposed and Congress passed an act authorizing a research vessel for the North Atlantic. Although we repeatedly requested funds to carry out this mandate of Congress, no money was forthcoming. The General Seafoods Corporation sold us an old trawler—the *Harvard*—for $1.00. When the Bureau of Fisheries was transferred to the Department of the Interior, almost the first act of Secretary Ickes was to allocate Public Works Administration money to rebuild the *Harvard* and convert it into a research vessel. Just before the work was completed the Navy took it over and reconverted it for Navy use. If the vessel should be released to us to-day it would be unsuitable for our work.

When Japan filed notice she would abrogate the Fur Seal Treaty, we secured an appropriation and purchased the *Black Douglass*. Necessary repairs were made, a crew was hired and scientific personnel made available to trace the migration of fur seals. The vessel sailed from Savannah, Georgia, arrived in Seattle, where investigation headquarters had been established, but a few days later was taken by the Navy. That's the tragic story of our efforts to get research vessels for the past ten years.

We need not one, but several research and fishing experiment boats. Some should be of the practical fishing vessel type such as purse seiners. We need two or three large research vessels capable of following migrations of pelagic species wherever they may roam in the sea.

To develop the latent fisheries of the United States it will be necessary to have team work among the Government, the fishermen and the processor. As I see the problem, it is the Government's responsibility to undertake the exploration of our waters. We need vessels equipped with various types of gear to ascertain the abundance of supply by species; to determine the extent to which the fishery can be utilized without threatening depletion; to locate the most productive banks; and to determine what measures should be taken to insure an adequate spawning stock, perhaps by setting aside nursery or spawning areas. Experiments should be conducted to ascertain what type of gear can obtain best results.

## THE ARGENTINE CITIZENS DECLARATION

THE following letter has been addressed to Secretary of State Hull by the American Association of Scientific Workers in appreciation of the declaration for effective democracy and American solidarity recently issued by distinguished citizens of the Argentine:

Many of our scientific colleagues and friends of Argentina, recognizing that democracy and human freedom are essential to the welfare of mankind and to the progress of science, recently joined with other leaders of Argentina in issuing a "declaration for effective democracy and American solidarity." A considerable number of scientists and educators, including men such as Professor Bernardo A. Houssay, Nobel laureate, Latin America's greatest scientist, were among the one hundred and fifty signers of the declaration.

We rejoice that our fellow scientists have taken the lead in rallying the Argentine people behind "those of the world fighting for democracy." The American Association of Scientific Workers honors the high purpose and courage of our Argentine colleagues. On our part, we pledge that we shall do our full share in the war against fascism and that we shall strive for a victorious peace and for a democratic world in which all peoples will live in solidarity.

The American Association of Scientific Workers notes with great distress that the signers of the declaration have been censured and, by order of the President of Argentina, dismissed from their posts in the universities and services for subscribing to a document which, in essence, simply approves the principles of democracy and calls for the cooperation of free men in its preservation. Some of the signers, such as Professors Houssay, Castex and Romano, are reported to have taken refuge in Uruguay.

The American Association of Scientific Workers affirms that the existence of such an anti-democratic policy in one of the great countries of the Western hemisphere is a menace to the welfare of all the peoples in this hemisphere. Recent events confirm our view. Our association further asserts that the failure of the democratic nations of this hemisphere to condemn officially and to exert pressure to rectify this action of the Argentine Government would be a serious error, first because great injustice has been done, and second because the cause of democratic nations is weakened by ignoring the suppression of liberty and democracy.

Therefore, the American Association of Scientific Workers respectfully but urgently suggests that the Government of the United States of America, in concert with other nations of this hemisphere, take whatever actions may be most effective to the end that the Government of Argentina rescind its undemocratic decrees.

(Signed) KIRTLEY F. MATHER, *President*
HARRY GRUNDFEST, *National Secretary*
*American Association of Scientific Workers*

## AWARDS OF THE AMERICAN INSTITUTE OF MINING AND METALLURGICAL ENGINEERS

AT the annual dinner and honors night of the American Institute of Mining and Metallurgical Engineers, which was held in New York City, on February 23, the Charles F. Rand Memorial Medal for distinguished achievement in mining administration was presented to Cornelius F. Kelley, chairman of the board of the Anaconda Copper Mining Company, and an associate of more than thirty companies.

The citation reads: "For conspicuous success as administrative head of great enterprises engaged in the production of non-ferrous metals at home and abroad; for inspiring leadership of an organization that has

trained able engineers for service wherever ores are mined and metals are recovered; for enhancing the prestige of metal mining in the financial and industrial world."

The William Lawrence Gold Medal "for distinguished achievement in mining" was presented to George B. Harrington, president of the Chicago, Wilmington and Franklin Coal Company of Chicago.

The Anthony L. Lucas Medal "for distinguished achievement in improving the technique and practice of finding and producing petroleum," was presented to Charles Ormer Millikan, chief engineer of the Amerada Petroleum Corporation, Tulsa, Okla., "for his outstanding contributions to engineering in the development and production of petroleum."

Selwyn Gwillym Blaylock, president and managing director of the Tadanac plant of the Consolidated Mining and Smelting Company of Canada, Ltd., at Trail, B. C., received a certificate of honorary membership in the institute "in recognition of his eminent standing as a metallurgist, engineer and administrator of mining and metallurgical enterprises and the effective and patriotic services he has rendered his country and the United Nations in these critical times."

The Robert W. Hunt Gold Medal and money prize given for "the best original paper on iron and steel contributed to the institute" was presented to Clarence D. King, metallurgist of the United States Steel Corporation of Pittsburgh.

The J. E. Johnson, Jr., award of a cash prize and certificate, given to metallurgists not over forty years of age for contributions to the metallurgy or manufacture of pig iron, was presented to Leonard A. Tofft, general foreman of the new blast furnaces of the Inland Steel Company at Indiana Harbor, Ind.

### THE RICHARD PEARSON STRONG MEDAL

THE American Foundation for Tropical Medicine, Inc., announces the establishment of an award for outstanding achievement in the field of tropical medicine to be awarded periodically as circumstances determine. This award is to be known as the Richard Pearson Strong Medal for distinguished achievement in tropical medicine. It consists of a paladium medal together with a cash honorarium of $500, the gift to the foundation of the Winthrop Chemical Company. The first award was presented to Colonel Strong at the annual meeting of the American Foundation for Tropical Medicine at the University Club, New York, on February 28. Admiral E. R. Stitt, M. C. (retired), former Surgeon General of the United States Navy, made the presentation. The citation reads:

The medal and award for distinguished achievement in tropical medicine has been established to honor outstanding contributors to this important field of the medical sciences. It is fitting that it should bear the profile and the name of a distinguished American physician who has devoted his career to this branch of medicine and whose name is known throughout the world. It is peculiarly appropriate that the first award should be made to him.

A scientist, who since his appointment in 1899 as president of the first Board for the Investigation of Tropical Diseases in the Philippine Islands, and subsequently as director of the Philippine Government Biological Laboratory in Manila, has made fundamental contributions to scientific knowledge of many tropical diseases, including bacillary and amebic dysentery, cholera, bubonic and pneumonic plague, beri-beri, yaws, tropical ulcer and tropical skin diseases, trypanosomiasis, typhus fever, filariasis, onchocerciasis—the blinding filarial disease of Africa and Central America—and Oroya fever.

Author of many important scientific articles and monographs dealing with tropical diseases and of the revised edition of the most distinguished American text on tropical medicine.

Leader of scientific expeditions to remote areas of the tropics of Africa and of the Amazon Valley, to Central America and the valleys of the Andes.

Samaritan, physician and leader of relief expeditions to the peoples of Manchuria stricken by a devastating epidemic of pneumonic plague, and later to Serbia which was in the throes of the great epidemic of typhus fever in 1915.

Teacher and professor of tropical medicine at the University of the Philippines from 1907 to 1913; professor of tropical medicine at Harvard University from 1913 to 1938; and organizer of the first graduate School of Tropical Medicine of the Western Hemisphere.

Past president of the American Society of Tropical Medicine, the American Academy of Tropical Medicine, the American Society of Parasitologists and the Association of American Physicians.

Eminent figure in military medicine; member of the Inter-Allied Sanitary Commission in the first World War; consultant in tropical medicine to the Secretary of War; director of the Course in Tropical Medicine at the Army Medical School; and member of the Medical Corps of the United States Army in four wars; recipient of the Distinguished Service Medal in 1919 for exceptionally meritorious and distinguished services, notably as president of the board for the Investigation of Trench Fever—Colonel Richard Pearson Strong.

## SCIENTIFIC NOTES AND NEWS

FOUR honorary members, one each from the four principal Allied Nations, have been elected by the British Institute of Metals. They are, for the United States, Dr. Irving Langmuir, associate director of the research laboratories of the General Electric Company; for Great Britain, Sir Lawrence Bragg, Cavendish professor of experimental physics at the University of Cambridge; for China, Madame Chiang

Kai-Shek, and for the U.S.S.R., Professor Peter Kapitza, director of the Institute for Physical Problems of the Academy of Sciences, Moscow.

THE Lamme Medal for 1943 of the American Institute of Electrical Engineers has been awarded to Arthur H. Kehoe, vice-president of the Consolidated Edison Company of New York, Inc., in recognition of "pioneer work in the development of alternating current works and associated apparatus for power distribution." It is expected that the medal and certificate will be presented to him at the summer technical meeting of the institute, which will be held at St. Louis from June 26 to 30.

DR. V. E. SHELFORD, professor of zoology at the University of Illinois, has been made corresponding member of La Sociedad Mexicana de Historia Natural.

THE Council of the British Institution of Electrical Engineers has elected Sir Ernest Thomas Fisk, since 1932 managing director and chairman of Amalgamated Wireless, Australia, an honorary member of the institution in appreciation of his services in Australasia in the field of radio-communications.

THE honorary doctorate of science was conferred on February 25 at the commencement of the Worcester Polytechnic Institute on Dr. Wallace W. Atwood, president of Clark University.

CLARKSON COLLEGE OF TECHNOLOGY, Potsdam, N. Y., conferred the degree of doctor of engineering on Thorndike Saville, dean of the College of Engineering of New York University, at the forty-fifth commencement exercises on February 13.

THE American Academy of Orthopedic Surgeons has awarded its gold medal to Colonel John L. Gallagher, M.C., A.U.S., in recognition of his work on the development of compression dressings for burns, wounds and frostbite.

DR. GEORGE BAEHR, professor of clinical medicine at Columbia University, who since 1941 has been medical director of the U. S. Public Health Service and chief medical officer of the U. S. Office of Civilian Defense, will retire from government service on March 1. He will be succeeded by Dr. W. Palmer Dearing, who has been assistant chief medical officer. In recognition of his services to the hospitals of the country in time of war, the American Hospital Association at its recent annual meeting voted a special citation to Dr. Baehr and elected him to honorary membership.

IGOR SIKORSKY, inventor of the helicopter adopted by the Army Air Forces, was presented on February 13 by Fawcett Publications, Inc., with the 1943 aviation Trophy and the sum of $1,000.

DR. NIELS BOHR, professor of theoretical physics at the University of Copenhagen, has been elected a member of the Athenæum Club, London, under a rule which permits the "annual election by the committee of a certain number of persons of distinguished eminence in science, literature or the arts or for their public services."

EARL RUSSELL (Bertrand Russell), who has lived in the United States for some years, has been elected a fellow of Trinity College, Cambridge. He expects to return to England during the summer to resume his work in philosophy and mathematics.

THE second meeting of the Oregon Academy of Science was held in Portland on January 15. An organization meeting without a program was held on October 27 last. Officers elected were: *President-elect*, Stanley Jewett, regional biologist, the U. S. Fish and Wildlife Service, Portland; *President*, the Reverend Jos. S. McGrath, professor of chemistry and dean of the College of Science of the University of Portland; *Treasurer*, R. R. Huestis, professor of zoology at the University of Oregon, re-elected. Dr. A. L. Strand, president of Oregon State College, previously head of the department of entomology, will remain on the council as past president for this year. The present secretary is F. A. Gilfillan, dean of the School of Science of the State College, who continues for the second year of his term of office.

THE following officers were elected on February 4 at the annual meeting of the Branner Geological Club of Southern California at the California Institute of Technology: E. Robert Atwill, of the Union Oil Company, *President;* Beno Gutenberg, of the California Institute of Technology, *Vice-president*, and Clifton Johnson, of the Richfield Oil Company, *Secretary-Treasurer*. The principal address was given by Hoyt S. Gale and Rodney Gale on the geology of the Kramer borax deposits in southern California; Earl C. Noble showed colored motion pictures of Costa Rica and Guatemala.

DR. WALTER RAUTENSTRAUCH, of Columbia University, has been appointed visiting professor of engineering during the spring term at the North Carolina State College, Raleigh.

DR. LOUIS J. CURTMAN, professor of chemistry at the College of the City of New York, who has been connected with the college since 1907, has retired from active service.

R. M. FOSTER, of the Bell Telephone Laboratories, has been appointed professor of mathematics and head of the department at the Polytechnic Institute of Brooklyn.

DR. CORNELIUS OSGOOD, associate professor and chairman of the department at Yale University, curator of the Peabody Museum, has been promoted to a professorship of anthropology.

WILL C. MCKERN, curator of anthropology at the Milwaukee Public Museum, has been appointed director of the museum, succeeding the late Dr. Ira Edwards.

CHRISTOPHER W. COATES, a member of the staff of the New York Aquarium, has been appointed curator of fishes at the New York Zoological Park. Myron Gordon, also of the aquarium, has been made assistant curator.

DR. W. S. FLORY, JR., from 1936 to 1944 main station horticulturist at the Texas Agricultural Experiment Station, has received appointment as horticulturist with the Virginia Agricultural Experiment Station at Blacksburg.

DR. R. E. MORTIMER WHEELER, director of the Society of Antiquaries and keeper of the London Museum, has been appointed director-general of archeology in India.

DR. HOBART A. REIMANN, professor of medicine at Jefferson Medical College, visited Puerto Rico in December as guest of the Puerto Rican Medical Association in San Juan, where he gave several lectures on acute infectious diseases.

DR. REGINALD FITZ, lecturer on the history of medicine at the Harvard Medical School, delivered on February 24 an address entitled "Medicine and the Changing World" at the New York Academy of Medicine. The meeting was presided over by Dr. John F. Fulton, Sterling professor of physiology at the School of Medicine of Yale University.

DR. C. H. BACHMAN, physicist of the electronics laboratory of the General Electric Company, gave a lecture on February 25 under the auspices of the chapter of Sigma Pi Sigma of New York University. He spoke on the new electron microscope developed by him and Dr. Simon Ramo.

DR. H. J. MULLER, professor of biology at Amherst College, delivered on February 9 a lecture before the division of biological sciences of the University of Rochester. His subject was "Our Mutations."

DR. JUSTIN L. POWERS, chairman of the Committee of National Formulary and director of the laboratory of the American Pharmaceutical Association, addressed the Science Club of the University of Georgia on February 24 on "Official Drug Standards."

DR. JOHN W. OLIPHANT, surgeon, Division of Infectious Diseases, National Institute of Health, will deliver the sixth Harvey Society Lecture of the current series at the New York Academy of Medicine on March 16. He will speak on "Jaundice Following Administration of Human Serum."

THE Federation of American Societies for Experimental Biology, by vote of the executive committee, will not hold an annual meeting in 1944. Through the medium of the *Federation Proceedings*, however, provision will be made for the publication of abstracts of papers which would have been presented if it were feasible to hold such a meeting. Similarly, provision will be made for the full publication of papers contributed to several symposia. This arrangement corresponds to that which was made in 1943 when the annual meeting was also cancelled. It is now announced that a meeting will be held in Cleveland on May 8, 9 and 10, 1945, unless some unforeseen difficulty arises. The federation is composed of the American Physiological Society, the American Society of Biological Chemists, the American Society for Pharmacology and Experimental Therapeutics, the American Society for Experimental Pathology, the American Institute of Nutrition and the American Association of Immunologists.

APPLICATIONS for grants from the Cyrus M. Warren Fund of the American Academy of Arts and Sciences should be received by the chairman of the committee, Professor Frederick G. Keyes, Massachusetts Institute of Technology, Cambridge 39, Mass., not later than April 15. Grants are made in aid of chemical research, generally for apparatus or supplies, or for the construction of special facilities needed for research in chemistry or in fields closely related to chemistry. Grants are not awarded for salaries, and on account of limited resources the amount to an individual is seldom in excess of $300. Application blanks may be obtained from the chairman upon request.

THE following chemicals are wanted by the National Registry of Rare Chemicals, Armour Research Foundation, 33rd, Dearborn and Federal Streets, Chicago, Ill.: 1,2,3,4-Tetrahydroxy benzene (Apionol), l-Amino-2,3-hydroxy propane, 3-Amino-2-naphthol, l-Amino-9-octadecene, Barium platinic chloride (1 lb.), Benzyloxy Carbonyl Chloride (carbobenzoxy chloride), p-Chlorophenyl acetic acid, Comenic acid, or any ester thereof, Chelidonic acid or any ester thereof (Monoester, preferably), 1,7-Dihydroxy-6-naphthoic-3-sulfonic acid, Dibenzyl disulfide, Di-n-hexylamine (10 lbs.), Hexaphenyl ethane, Indazole (50 g), o-Iodosobenzoic acid, 2 Mercapto-1,3,4 thiadiazole and Stachydrine.

A SYMPOSIUM, sponsored by the division of industrial and engineering chemistry, on the post-war outlook for the chemical industry, will be held in connection with the one hundred and seventh meeting of the American Chemical Society which meets in Cleveland from April 3 to 7 under the presidency of Dr. Thomas

Midgley, Jr. Subjects to be discussed include financial problems of the transition period, the outlook for foreign trade in chemicals, the need for more intensive research, the prospect for new engineering developments, the enhanced importance of technical progress to management and trends in professional education. Dr. Lawrence W. Bass, director of the New England Industrial Research Foundation, will be chairman of the symposium. Ralph E. Flanders, president of Jones and Lamson Machine Company, Springfield, Vt., chairman of the Research Committee of the Committee for Economic Development, will deliver an address on "Technology and Industrial Management." Other speakers will be D. M. Sheehan, comptroller of the Monsanto Chemical Company, St. Louis; Dr. W. L. Badger, of Ann Arbor, manager of the consulting engineering division of the Dow Chemical Company; John B. Glenn, president of the Pan American Trust Company, New York, vice-president of the New York Board of Trade; Raymond Stevens, vice-president of Arthur D. Little, Inc., Boston, and Dr. H. S. Rogers, president of the Polytechnic Institute of Brooklyn.

THE late Lady Thomazine Mary Lockyer, widow of the astronomer Sir Norman Lockyer, bequeathed her residence and other house property to the Norman Lockyer Observatory Corporation, and the residue of her estate in trust for the benefit of the corporation. She left £100 to the British Association for the Advancement of Science.

*The Times*, London, reports that a grant of £28,600 has been made under the Colonial Development and Welfare Act to enable a tuberculosis survey to be made in Fiji, to determine the extent of the problem and the best means of dealing with it. It is hoped to extend the survey to the British Solomon Islands Protectorate and the Gilbert and Ellice Islands Colony.

*Nature* reports that the shipbuilding industry in Great Britain, after consultation with the Department of Scientific and Industrial Research and the Admiralty, has decided to establish a British Shipbuilding Research Association, to develop all branches of research associated with shipbuilding, marine engineering and ship repairing.

# DISCUSSION

## FLOCCULAR MASSES AND APPARENT ALTERATIONS IN SUNSPOT PENUMBRAE

IT is well known that high level, cloud-like masses of ionized Ca and other atoms are related in some way to ordinary sun spots. They are observed to be unusually active in the immediate neighborhood of spots and to partake of the vortical movement of the solar atmosphere about such spots. Unlike the spots, however, individual flocculi can not be observed by direct vision. Observation of the various kinds of flocculi are by spectroheliograms, generally obtained in the K line of Ca for that element, in the H$\alpha$ line for H, and so on.

Some time ago it occurred to the writer that under certain conditions floccular masses composed of various atoms and having a general absorption and emission might be seen by direct vision, or at least might be demonstrated by the masking effect such masses would have in passing over the dark parts of a sun spot.

That flocculi of various kinds, both Ca and H, for instance, overlie spot groups is, of course, common knowledge. However, the writer proposes that certain apparent changes in the penumbrae of sun spots may often be illusionary, due to the movements of superimposed floccular masses, having general emission and absorption, which are thus rendered directly visible. Both Ca and other atoms may be supposed to share in the phenomenon.

It was shown by Hale that sun spots have magnetic fields centered on the umbrae, which fields appear to derive from the rotation of charged particles. Sun spots, therefore, are vortices. However the vortex itself may be formed, the genesis of a spot appears to be as follows:

An ascending convection current, rising above the photosphere, reaches levels of reduced pressure where the top of the column expands. Heat is lost by expansion and the temperature of the expanded gas falls several thousand degrees relative to the photosphere. Its visible radiation decreasing proportionately, the cloud thus formed is seen as a relatively dark spot against the brilliant photospheric background. This constitutes the umbra of a sun spot. Surrounding it is a periphery of more diffused gases forming the penumbra. This penumbra is commonly and evenly striated and in most cases appears to slope inward and downward towards the umbra. Striation of the penumbra appears to be caused by currents flowing inward and outward to and from the umbra. Essentially, therefore, a sun spot is a funnel-shaped cloud roughly similar to a terrestrial tornado.

Bearing in mind the above facts certain striking metamorphoses are occasionally observed in the penumbrae of sun spots, difficult to explain on the assumption that such changes are real.

A spot is sometimes observed to lose its penumbra entirely on one side, retaining it on the opposite; and the lost portion is frequently regained. Other spots

are observed in which the penumbra alternately expands and contracts on both sides of the umbra. Since such changes are also frequently accomplished without any apparent effect on the striation of the penumbra, the question may be asked whether they are real or illusionary. The writer believes that all such changes, in which the striation is not affected, are only apparent and due to the masking effects of flocculi moving above the penumbra.

The striation of the penumbra may be used to separate real from apparent changes quite readily. Remembering that this whole structure is gaseous, it is clear that any profound alteration in the penumbra itself will certainly affect the striation by disturbing the currents which produce it.

Consider the case of a spot which suddenly appears to be dichotomized, say 24 hours after first observation, the penumbra appearing to vanish on one side while it remains whole and unaffected on the other and with no sensible disturbance of the striation in the visible half. Assuming such a change to be real we would have to believe that a vortex existed in which there was an indraught *only from one side,* an obvious impossibility.

The simplest explanation for such an appearance (by no means rare) is that some bright, opaque screen has come between the penumbra and the eye of the observer. This is most strongly suggested when the missing half of the penumbra reappears, the striation in the unaffected half meanwhile remaining undisturbed.

In order to cause apparent changes in the shape and area of the penumbra, without actually altering it physically, it seems clear that the agent effecting the apparent change must be in the nature of a screen superimposed upon but at a considerable altitude *above* the spot. Indeed the phenomenon is analogous to the projection of prominences on umbrae, which give rise to the bright bridges often observed; but the difference in volume between the slender umbral filaments and the obscuring masses which blot out whole areas of the penumbra make it fairly certain that the latter are floccular in nature. By learning to distinguish between physical changes in the penumbra and those caused by obscuring flocculi, it is thus possible to study their local movements by direct vision.

JAMES C. BARTLETT, JR.,
*Chairman, Astronomical Section*
AMERICAN INTERNATIONAL ACADEMY, INC.,
BALTIMORE, MD.

## PERTUSSIS IMMUNE ROOSTER SERUM

As a member of the American Association for the Advancement of Science I am greatly interested in the current article by Hilleman and Gordon in SCIENCE for October 15, 1943, relative to the preparation of a protective rooster antiserum against mouse pneumonitis virus.

I wonder whether or not the authors are familiar with the work of Dr. John Bailey, of the University of Indiana,[1] who in 1933 described an anti-serum of high potency produced in the rooster by repeated intraperitoneal inoculations of suspensions of live *H. pertussis.*

Bailey's serum was effective in alleviating to a considerable degree the paroxysmal cough in the early stages of pertussis in a limited number of children when administered intramuscularly. However, local reactions were at times severe and wide-spread usage of the serum was not attempted.

Three years ago I again became interested in the rooster as a possible source of immune serum particularly against type b *H. influenzae* for the treatment of influenzal meningitis in children, as past experience had demonstrated the failure of chemotherapeutic agents and antisera in the treatment of this disease. Approximately two years ago I submitted a problem to the research committee of the Michael Reese Research Foundation, Chicago, involving an attempt to produce a potent rooster immune against type b *H. influenzae* for the treatment of influenzal meningitis. The initiation of this work was curtailed when I entered the Army.

RALPH H. KUNSTADTER,
*Major, M.C., AUS.*
ASHFORD GENERAL HOSPITAL,
W. VA.

## A PROPOSAL CONCERNING THE KILGORE BILL

BECAUSE its arguments were based on generalities L. A. Hawkins (SCIENCE, January 14) criticizes my letter on the Science Mobilization Bill (SCIENCE, November 26, 1943). Since I was attempting to answer an earlier letter of Dr. Harlan T. Stetson (SCIENCE, October 22, 1943), to whose generalizations I objected, my reply was not an answer to specific objections to the bill.

Mr. Hawkins's interpretation of my remarks perverts my meaning and intention, perhaps because they were not clear. However, instead of offering specific answers to his specific objections to my general statements, I urge opponents and proponents of the bill to direct their efforts in exactly the manner he desires. If the less informed scientific public could have before it objective and specific analyses prepared by competent persons of divergent views, I believe the formulation of sound judgment would be hastened. I suggest, therefore, the publication and wide circulation of specific objections and specific answers to them.

[1] *Jour. of Infect. Dis.* 52: 97, 1933.

Such analyses should be in compact and understandable form and free from extravagant subjective opinion and emotional appeal.

I propose this in the interest of creating an informed opinion, though I do not concede the irrelevance or unimportance of certain far-reaching generalities that must form a background of any opinion that is reached.

LELAND H. TAYLOR
WEST VIRGINIA UNIVERSITY

# SCIENTIFIC BOOKS

## THE HISTORY OF BOTANY

*A Short History of the Plant Sciences.* By HOWARD S. REED. 323 pp. 37 figs. Volume VII of A New Series of Plant Science Books, edited by Frans Verdoorn. Waltham, Mass.: The Chronica Botanica Company. 1942. $5.00.

REED'S "Short History" is more than a dry record of progress. Through the kind and appreciative eyes of one of America's best-liked botanists the kaleidoscopic change in scenes and actors on the stage of botanical progress becomes a vivid adventure. This book will be enjoyed not only by professional botanists but also by students and others.

The first half of the book will appeal especially to those already versed in the history of botany, since it discusses many salient but generally neglected aspects of botany. Among these should be mentioned the chapters entitled "The Gardeners and Herbalists of Antiquity" and "Gardens and Other Things." In both of these the role of primitive agriculturists and horticulturists in the development of our knowledge of plants is stressed. Even though no written records of their activities are preserved, thus making the task of the historian difficult, their actual contributions, in the form of domesticated plants and cultural practices, are of such magnitude that our own work—although properly recorded and published—is dwarfed by them.

The middle portion of the book is most detailed, and the botanists of the seventeenth and eighteenth centuries receive considerable attention. This part conforms most closely to existing texts, but the evaluation of the work of these scientists is based on original research and is not a mere restating of current opinions. One might expect such conformity, since after more than 200 years the historian can estimate the influence of his predecessors with far greater certainty than that of more recent investigators in fields which are at present in a state of flux. In the latter case only a person actively engaged in research in such fields is in position to give a proper historical account, in which more than mere facts are recorded.

In the third part of the book a limited number of fields of research have been selected, and the development of each is traced to the present time. The choice of these fields was mainly determined by Dr. Reed's own interests and research activities, which are of a remarkably wide scope. In this manner plant geography, morphology, cytology, mycology, plant pathology and various plant physiological topics are dealt with in eleven chapters. Although some readers might wish the inclusion of certain other subjects, such as taxonomy, agriculture or growth and plant movements, the reviewer, for one, is glad that the author has chosen the adequate treatment of a selected number of subjects rather than an abbreviated encyclopedic treatment of all phases of botany. As it stands, the book is very readable and should be required reading for all more advanced students in biology. It gives a welcome addition to the diet of currently accepted facts on which most students are reared, and it will help in giving them a proper perspective, which becomes harder to attain as specialization progresses.

This book is thoroughly original, in scope and treatment as well as in illustrations. We do not find the traditional portraits of the paragons of science, which often are of questionable authenticity and usually are entirely non-committal as to the character of the subject. Instead, original illustrations of significant experiments, laboratories or publications are depicted, with delightful originality. One of the special values of the book is the adequate, though not undue, stress laid on the contributions of American scientists. The reviewer was surprised to find how seldom he disagreed with the author, which can only be attributed to the care with which Dr. Reed has considered each contribution and the sympathy with which he has treated each contributor. It is easier to criticize mistakes than to appreciate positive advances, which become incorporated in our general body of knowledge and which can be recognized as advances only after careful consideration.

The Chronica Botanica Company and its active editor should be commended for their initiative in bringing this book, for which a definite need existed, before the public.

F. W. WENT
CALIFORNIA INSTITUTE OF TECHNOLOGY

## THE THEORY OF RINGS

*The Theory of Rings: Mathematical Surveys, No. 2.* By NATHAN JACOBSON. vi + 150 pp. New York: The American Mathematical Society. $2.25. 1943.

THIS is the second book in a new series of expository books entitled "Mathematical Surveys" which is edited and published by the American Mathematical

Society. The books of this series are expected to be authoritative and comprehensive within the field covered up to the time of publication. They will be of incalculable value to research mathematicians, who until the war were largely indebted to foreign publishers for such treatises. The present book by Jacobson is a worthy member of this series. It is not, however, recommended to the beginner.

The ring is the present evolutionary form to which linear algebras and hypercomplex systems are ancestral and of which they are special instances. The modern structure theory of linear algebras dates from the publication in 1907 of Wedderburn's thesis, and the structure of rings dates from Artin's paper of 1927. The representation theory of rings and their ideal theory is due to Emmy Noether and many other workers.

The author divides his subject into three parts: structure theory, representation theory and arithmetic ideal theory. In Chapter 1 he lays the foundations of the theory of endomorphisms of a group and throughout the book makes extensive use of the theory of rings of endomorphisms. By using the regular representations, the theory of abstract rings is obtained as a special case of the more concrete theory of endomorphisms. Moreover, the theory of modules, and hence representation theory, may be regarded as the study of a set of rings of endomorphisms all of which are homomorphic images of a fixed ring.

Chapter 2 deals with vector spaces and Chapter 3 with the arithmetic of non-commutative principal ideal domains. Chapter 4 is devoted to the development of these theories and to some applications to the problem of the representation of groups by projective transformations and to the Galois theory of division rings. The first part of Chapter 5 treats the theory of simple algebras over a general field; the second part is concerned with the theory of the characteristic and minimum polynomials of an algebra and the trace criterion for separability of an algebra.

The book is practically self-contained and embraces in its 150 pages a large amount of factual material. Such conciseness is obtained at the expense of elegance of typography, for many equations which would have looked better in displayed form have been run into the text. But this is a minor criticism of a book which is well planned and executed in a masterly manner.

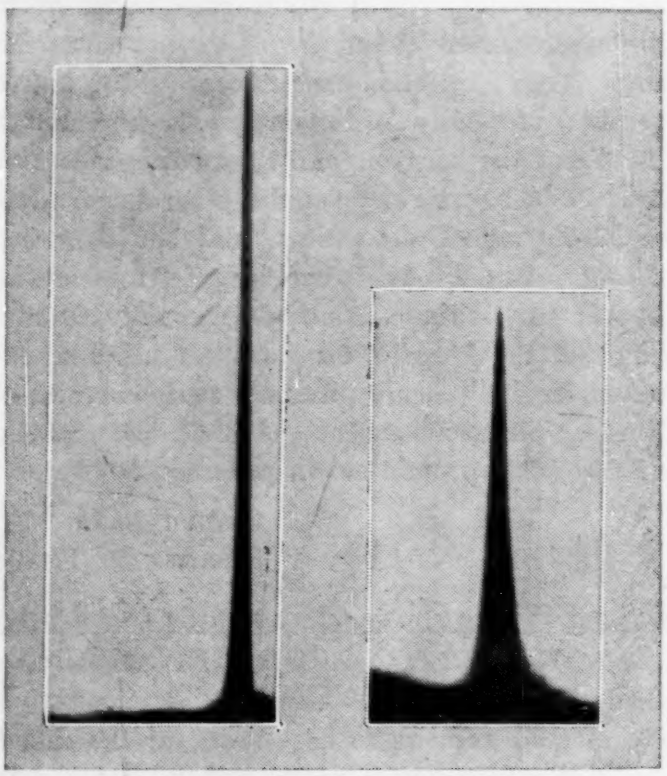
C. C. MACDUFFEE
UNIVERSITY OF WISCONSIN

# SPECIAL ARTICLES

## THE ISOLATION OF PITUITARY GROWTH HORMONE[1]

IN this paper a method is described for the isolation of a protein from the anterior lobes of ox pituitaries which electively causes the resumption of body growth in hypophysectomized rats and which behaves as a single substance in electrophoresis.

The 2.0 *m* $(NH_4)_2SO_4$ precipitate of the $Ca(OH)_2$ extract[2] from the acetone dried powder of freshly dissected anterior lobes of ox pituitaries was made by a method previously described.[3] The precipitate was suspended in water and dialysed until free from electrolytes. The insoluble material after dialysis was dissolved in water and brought to pH 4.0 with 1.0 *m* HCl; a saturated NaCl solution was then added until the concentration was 0.1 *m*. A precipitate formed. The 0.1 *m* NaCl precipitate, found to be devoid of growth activity, was removed by centrifugation. The supernatant was brought to 5.0 *m* with solid NaCl,



(A) (B)

FIG. 1. Electrophoretic patterns of ascending boundaries of pituitary growth hormone preparations. (A) in pH 4.00 acetate buffer and (B) in pH 9.80 borate buffer after the current has been put on for 135 and 140 minutes respectively with a potential gradient of about 6 volts per cm.

[1] From the Institute of Experimental Biology, University of California, Berkeley. Aided by grants from the Rockefeller Foundation, New York City; the Josiah Macy Jr. Foundation, New York City; and the National Research Council Committee on Research in Endocrinology.

[2] All procedures were performed at 2 to 3° C.

[3] W. Marx, M. E. Simpson and H. M. Evans, *Jour. Biol. Chem.*, 147: 77, 1943.

and the precipitate formed was dissolved in pH 4.0. This NaCl fractionation was repeated twice. The final 5.0 *m* NaCl precipitate was dissolved in water and dialysed until salt-free. The dialysed solution was adjusted to pH 5.7–5.8 and the precipitate[4] formed was centrifuged off. The supernatant was then made alkaline and adjusted to pH 8.7–8.8, the precipitate[4] again being removed by centrifugation. The clear fluid was then next brought to 1.65 *m* $(NH_4)_2SO_4$ at pH 7.0. The $(NH_4)_2SO_4$ precipitate was dissolved in water and dialysed. The pH and $(NH_4)_2SO_4$ fractionation was repeated twice. The dialysed solution of the final 1.65 *m* $(NH_4)_2SO_4$ precipitate was made to pH 5.7–5.8. After the precipitate was removed by centrifugation, the supernatant was adjusted to pH 8.7–8.8. The precipitate formed was centrifuged off and the supernatant fluid brought to pH 6.8–6.9. The resulting precipitate was next dissolved in slightly acid solution and the isoelectric precipitation repeated twice.

The final pH 6.8–6.9 precipitate was examined in a Tiselius electrophoresis apparatus[5] using the scanning method of Longworth.[6] Experiments were carried out over a range of pH values from a pH 4.0 to 9.8 at a constant ionic strength of 0.10 using the acetate and borate buffers at 1.5°. In all these experiments the material appeared as a single substance (Fig. 1) with an isoelectric point at pH 6.85.

All biological assays were performed in female rats hypophysectomized at an age of twenty-seven days. Intraperitoneal injections were begun about fourteen days later, once daily for ten days. It was found that 0.010 mg of the hormone daily caused an increase of 10 gm in body weight. On the other hand, a total dose of 5.0 mg of the product did not show lactogenic, thyrotropic, adrenocorticotropic, follicle-stimulating or interstitial-cell stimulating activities, indicating that the preparation was substantially free of other biologically active pituitary contaminants.

Further physico-chemical and biological characterizations of this protein are in progress.

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## THE CHEMICAL REMOVAL OF SALTS FROM SEA WATER TO PRODUCE POTABLE WATER[1]

No method appears to be known for the chemical removal of salts from sea water; in fact, such a method has been considered impossible by some.[2] The method herein described should therefore be of interest. The general principle involved is the addition of a sufficient quantity of a suitable base to precipitate the anions present followed by the addition of a sufficient quantity of a suitable acid to precipitate the cations. The method actually used is a special case of this general principle in that both the base ($Ag_2O$) and acid (uric acid) used as precipitants are practically insoluble; this fact obviates the necessity of accurate measurement of these reagents.

The chemical reactions in the order in which they are carried out may be illustrated as follows:

$$(1)\quad 2\overset{+}{Na} + 2\overset{-}{Cl} + Ag_2O + H_2O = 2\overset{+}{Na} + 2\overset{-}{OH} + 2AgCl$$

$$(2)\quad \overset{+}{Na} + \overset{-}{OH} + \text{uric acid} = \text{Na-urate} + H_2O$$

The AgCl is filtered off before the addition of the uric acid. The solution is again filtered after reaction (2), the filtrate of which is nearly free of dissolved materials (see below). The reactions above are written for the precipitation of NaCl; but most of the other important salts present in sea water appear to react in the same manner. However $Ca^{++}$ and $Mg^{++}$ would also be partly or wholly precipitated as hydroxides in reaction (1). The sulfate ion would not be expected to precipitate since $Ag_2SO_4$ is fairly soluble.

The following data show the experimental procedure and typical results obtained with artificial (McClendon's) sea water:[3]

| Solution | Amount (cc) | pH | Total solids (gms/100 cc) | Remarks |
|---|---|---|---|---|
| 1. Art. sea water | 1,000 cc | ca. 7 | 3.40 | solution clear and colorless. |

0.35 moles of $Ag_2O$ added gradually over a period of about 20 minutes with stirring. Solution filtered immediately. Completion of reaction determined by persistence of brown $Ag_2O$ in beaker.

| Solution | Amount (cc) | pH | Total solids (gms/100 cc) | Remarks |
|---|---|---|---|---|
| 2. Filtrate from (1) | 1,000 cc | 10 | 2.17 | solution clear; brown in color. |

0.6 moles of uric acid added and solution stirred for about 20 minutes. Completion of reaction determined by noting fall of pH to near neutrality with indicator paper.

| Solution | Amount (cc) | pH | Total solids (gms/100 cc) | Remarks |
|---|---|---|---|---|
| 3. Filtrate from (2) | 790 cc | ca. 8 | 0.58 | solution clear; sl. brownish. |

To determine how much of the total solids was urates and uric acid, a 20 cc portion of the filtrate from (3) was acidified with 1 N HCl to pH 3. A white precipitate soon formed. After standing a few

[4] Both the pH 5.8 and pH 8.8 precipitates were found low in growth activity.

[5] A. Tiselius, *Trans. Faraday Soc.*, 33: 524, 1937.

[6] L. G. Longsworth, *Jour. Am. Chem. Soc.*, 61: 529, 1939.

[1] The manuscript of this article was received on January 30, 1943. Publication was postponed at the request of the committee on medical research of the Office of Scientific Research and Development.

[2] R. F. Braddish and others, *Jour. Am. Med. Asn.*, 120, 683, 1942.

[3] C. G. Rogers, Textbook of Comparative Physiology, p. 154. New York: McGraw-Hill, 1927.

minutes, the solution was filtered. The total solids determined on the filtrate was 0.45 gms 100 cc.

### DISCUSSION

*Water yield.* About 80 per cent. water recovery was obtained in the above experiment. The unrecovered water was retained in the urate precipitate. Additional water loss would occur if dry $Ag_2O$ was used; for in the above experiment the $Ag_2O$ was made from $AgNO_3$ and was not completely dry.

*Toxicity.* There is no reason to believe that the final product would be toxic. The small amount of dissolved materials (0.58 per cent.) is apparently composed of urates (0.13 per cent.) and an undetermined fraction (0.45 per cent.). This latter is probably sulfate (see above); since theoretically there should be 0.41 per cent. sulfate, calculated as $Na_2SO_4$, remaining in solution. In molarity, this is 0.029 moles per liter which is of sufficiently low concentration to serve as drinking water.

*Taste.* The water has a slightly salty taste and is not unpleasant to drink.

### SUMMARY

A simple chemical method is described for the removal of most of the salts from sea water. The final product, containing 0.58 per cent. dissolved material which is apparently composed of urates and sulfates, is not unpleasant in taste and is not expected to cause toxic effects if used as drinking water.

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## A PRELIMINARY ELECTRON MICROSCOPE STUDY OF THE ACTIVE DEPOSIT FROM RADIOTHORIUM

EARLY investigations of the separation of active substances by the recoil method showed that a small quantity of the parent substance is always present on the collecting plate. One explanation of this phenomenon is that the active deposit consists of aggregates of atoms. When one of the atoms disintegrates by the ejection of an alpha particle the compact aggregate of atoms recoils. Some of the recoil aggregates are deposited on the collecting plate. Lawson[1] found conclusive evidence for the theory in a study of polonium active deposit and named the phenomenon "aggregate recoil." Chamié[2] proved the existence of aggregates in the active deposits of thorium, actinium and radium by her radioautograph technique. Harrington[3] also found evidence of aggregates in radium active deposit.

After repeating a Chamié radioautograph with an active deposit of thorium, a new technique, that of observation with the electron microscope, was used for a visual investigation of the nature of the active deposit. The usual specimen holder, collodion film supported on 200-mesh copper screen, was the surface on which the active deposit of thorium was collected. The screens were photographed in place in the microscope. The photographs were enlarged to give a final magnification of 80,000 × for convenient observation and measurement of particle size.

Samples which had been exposed to the emanations from radiothorium for three, five and eight days were observed. The three-day sample exhibited diffuse spots ranging in size from 20 to 50 millimicrons in diameter. The median diameter was 29 millimicrons. The particle size range of the five-day sample was from 12 to 50 millimicrons with a median diameter of 21 millimicrons. The particle size was much smaller on the eight day sample with a range of 10 to 27 millimicrons. The median diameter was 18 millimicrons. The density of the deposit increased with increasing time of exposure to the emanations. The relative densities expressed in number of particles per square centimeter are 1, 3 and 12 for increasing exposure time. After standing for eight days, the eight-day sample was rephotographed. A deposit of uniform density was observed.

The electron microscope photographs show the aggregates in the active deposit of thorium. The change in the nature of the deposit on standing and the relation of the size distribution of the aggregates to length of exposure to thorium emanations indicates that when an atom of the aggregate disintegrates by the loss of an alpha particle the recoil force is sufficient to cause the aggregate to break up scattering the atoms in all directions.

The same phenomena, though more spectacular, have just been observed for deposits from radon. Fairly large aggregates appear after 30 minutes exposure, while after 1 hour, extraordinary small (maximum about 50 Angstrom units), sharply defined particles appear in the electron micrographs.

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1 R. W. Lawson, *Nature,* 102: 465, 1919.

2 C. Chamié, *Compt. Rend.,* 186: 1838–40, 1928.

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# SCIENTIFIC APPARATUS AND LABORATORY METHODS

## A NEW CONTACT LENS FOR VIEWING THE ANGLE OF THE ANTERIOR CHAMBER OF THE EYE

THE angle of the anterior chamber of the eye is hidden by opaque tissues and by total internal reflection at the outer surface of the cornea. It is possible to examine the chamber angle by use of a contact lens which eliminates internal reflection and creates a visual angle which passes behind the limbus.

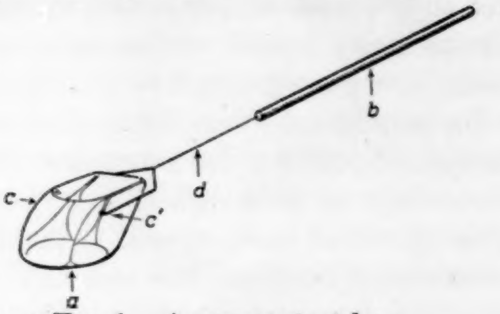


FIG. 1. A new contact lens.

A new instrument is introduced as an improvement over lenses now in use. As illustrated in Fig. 1, it consists of a new type of contact lens *a* and a handle *b* which are connected by a forked spring wire *d* pivoted at *c* and *c′*. This flexible spring wire permits the lens to be held in position without damage to the surface of the cornea. The lens is made of E. I. du Pont's plastic, H. C. 208 or of lucite, the former being preferable, since it does not scratch as easily, takes a finer optical surface and may be sterilized in boiling water. The quality of its internal reflection is excellent. Glass might be used but is heavier and more fragile than the plastics.

The concave contact surface, A (Fig. 2), of the lens has a diameter of 10 mm and a radius of curvature of 7.86 mm. Since the outer surface of the average cornea has a radius of curvature of 7.84 mm, a capillary film of tears forms between the lens and cornea when the two are in apposition (a drop of normal saline or other suitable solution may be used to wet the contacting surface of the lens before application). This film creates optical continuity between the contact lens and cornea and also serves to hold them together.

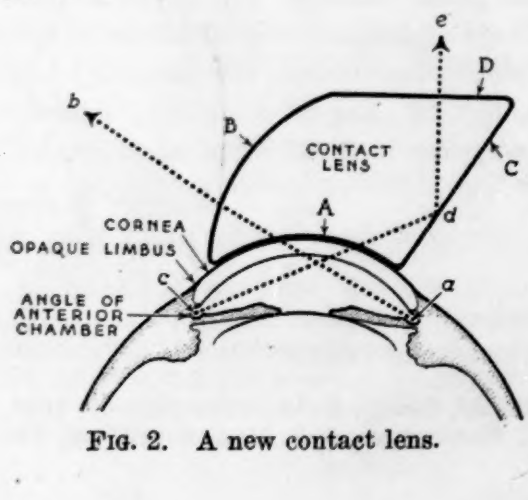


FIG. 2. A new contact lens.

When the lens is on the cornea (Fig. 2), a ray of light from a point *a* in the chamber angle is not reflected internally as before, but continues with little refraction to *b*. Refracting surface, B, which may be molded or ground with any desired magnifying power, is used with the loupe or unaided eye. On the opposite side of the lens, plane surfaces, C and D, form a reflecting prism. Reflecting surface, C, is not silvered; instead, total internal reflecting properties of glass or plastic are utilized. A ray of light from *c* is reflected at *d* to the observer at *e*. This prism is designed for use in combination with a standard slit lamp biomicroscope. The prism may be rotated on the cornea, and emerging rays, at any point in rotation, are directed toward the binoculars.

All other contact lenses used for this purpose depend upon the lids and sclera for support and include a deep liquid chamber between the lens and outer surface of the cornea. The lids frequently displace the lens, permitting air, which destroys optical continuity, to enter the liquid chamber. Furthermore, pressure of the lids, through the lens contact on the sclera, may create distortion of the tissues. For these reasons, only a few groups of workers have used gonioscopy routinely.

These objectionable features are not present in the new instrument; therefore, it is more practical for general clinical use.

Variations in lens surfaces and prism combinations are possible when the principles of the capillary film and the flexible supporting unit are used. Experiments with such variations are proposed and may be reported in the future.

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